Geophysical Research Abstracts
Vol. 16, EGU2014-13066, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

The evolution of subglacial water pathways and catchment areas derived from observed ICESat and CryoSat-2 ice surface elevation changes at the Siple Coast, Antarctica

Sebastian Goeller, Malte Thoma, and Klaus Grosfeld
Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

The mass export of the West Antarctic Ice Sheet (WAIS) is dominated by fast flowing ice streams which transport ice from the interior of the ice sheet towards its coast lines with velocities of several hundred meters per year. Understanding their dynamics is considered as a key to estimate the contributions of the WAIS to global sea level rise. This study focuses on the Ross Ice Streams (RIS) at the Siple Coast where observations reveal a high variability of ice stream pathways and velocities in the past. A widely spread and meters thick basal layer of unconsolidated sediments beneath the ice sheet creates the precondition for high basal sliding rates by sediment deformation. However, the exact locations of the RIS are determined by the pathways of basal melt water flow. We compute the subglacial water flow paths for the present-day ice sheet geometry with a balance flux approach and find high correlations between areas of enhanced subglacial water flow and the locations of the RIS. Moreover, the ice flow velocities of the particular ice streams are found to be correlated with the sizes of the water catchment areas draining underneath. For projections we apply surface elevation change rates observed by ICESat and CryoSat-2 to the present-day ice sheet geometry for 200 years and thus estimate the evolution of basal water pathways and catchment areas at the Siple Coast. The results of the simulations using the elevation change rates derived by the particular satellite campaigns show a high consistency. According to them, a major hydraulic tributary of the Kamb and Whillans Ice Stream (KIS and WIS) will be redirected underneath the Bindschadler Ice Stream (BIS) within the next 200 years. The water catchment area feeding underneath the BIS is estimated to grow by about 50% while the lower part of the stagnated KIS becomes increasingly separated from the upper hydraulic tributaries of the Siple Coast. This might be a continuation of the subglacial hydraulic processes which caused the past stagnation of the KIS and could also explain the observed deceleration of the WIS. Furthermore, this might also lead to a future increase of the ice velocities within the BIS and an increased ice drainage of the corresponding hinterland.